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Research Note

Babesia thylacis (Apicomplexa: Babesiidae) in a Northern Quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae), from Western Australia

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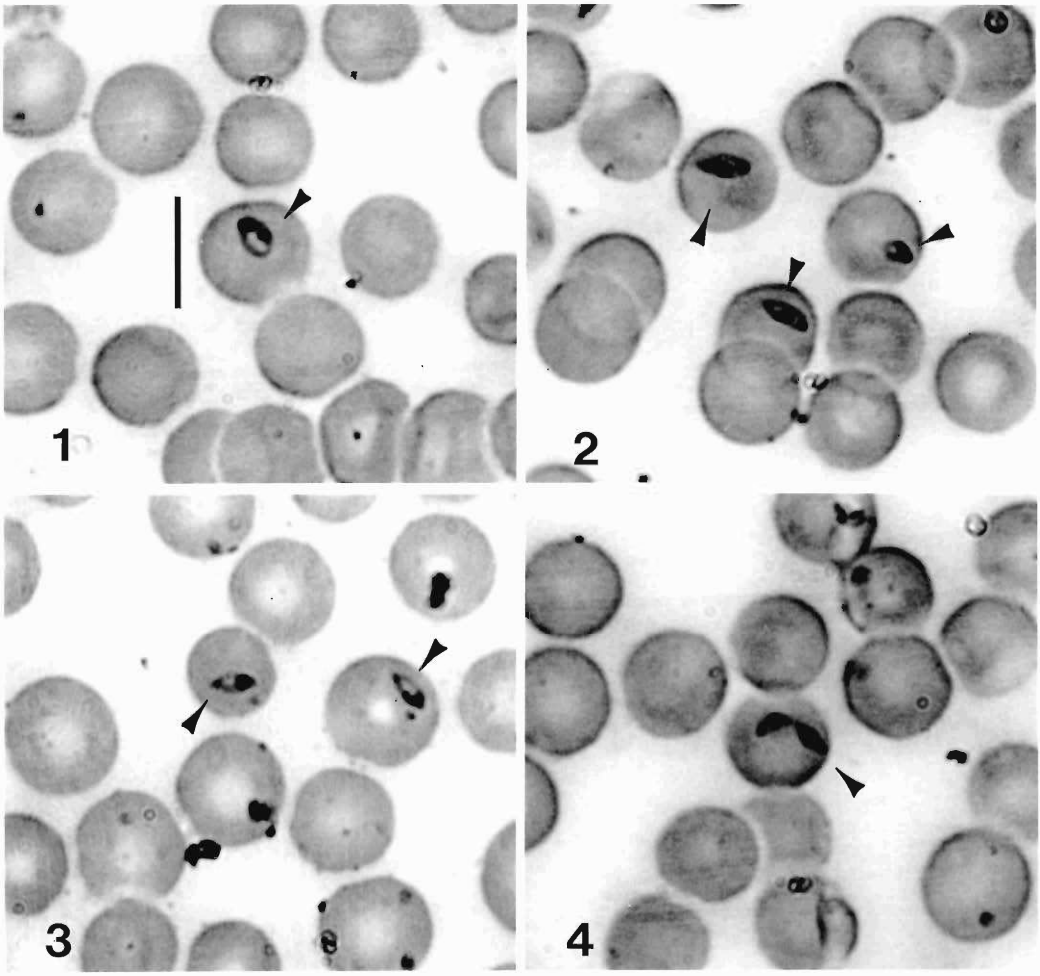
ABSTRACT: *Babesia thylacis* Mackerras, 1959, is provisionally identified and described from a stained blood smear obtained from a female northern quoll, *Dasyurus hallucatus* (Gould, 1842), captured on the Mitchell Plateau, Kimberley, Western Australia. This represents the third known natural host of this parasite and the first published account of its presence in Western Australia. *Babesia thylacis* has so far been found only in small carnivorous or insectivorous marsupials from Australia. Parasite morphology is characteristically pleomorphic, ranging from small amoeboid organisms to fully grown, pyriform protozoans, either single or paired, 2–4 by 1–1.5 μm. In most cases, mature parasites contain a prominent vacuole with a rounded nucleus either centrally or terminally located. Nuclear material that was elongated and stretched out along the periphery of some organisms was not uncommon. Infected red blood cells commonly contained only 1 parasite and occasionally paired merozoites.

KEY WORDS: Apicomplexa, Sporozoea, Piroplasmida, Babesiidae, *Babesia thylacis, Dasyurus hallucatus,* northern quoll, Marsupialia, Dasyuridae, Western Australia.

As part of an ongoing study on the prevalence and distribution of blood parasites in Indonesian mammals, numerous unstained blood smears were kindly lent to us by the Western Australian Museum, Perth, for staining and examination. We report on 1 specimen that had been collected many years earlier (17 July 1982) by W. A. Maxam from a captured female quoll identified as *Dasyurus hallucatus* (Coll. No. 11–35, Western Aust. Mus.) from the Mitchell Plateau (14°37′S, 125°52′E), Kimberley, Western Australia. In 1993, the thin peripheral blood film was fixed in methanol and stained for 15 min with Giemsa diluted 1:15 in pH 7.2 sodium phosphate buffer prepared from deionized water, revealing the *Babesia* described herein. Photomicrographs (Figs. 1–4) were processed and measurements made using a micrometer while examining parasites under a high oil immersion objective (× 1,000). The permount blood film (No. M21944) is deposited in the Department of Biogeography and Ecology, Western Australia Museum, Perth, Western Australia, 6000.

Parasites were found only in erythrocytes at a density of 5–10 per microscopic field of blood. Morphology was characteristically pleomorphic, ranging from small amoeboid to larger filiform organisms to fully grown, pyriform parasites, either single or paired, 2–4 by 1–1.5 μm. This parasite is considered a "large" *Babesia* based on the size of the intraerythrocytic parasites. Despite the age of the unstained blood film (~11 yr), the resultant staining was remarkedly good. The background coloration of stained erythrocytes were pink. Cytoplasm was a dull blue, concentrated to diffuse, and often vacuolated. Chromatin was often a bright reddish-purple. The nucleus was rounded and either centrally or terminally located. Nuclear material that was elongated and stretched out along the periphery of some organisms was not uncommon. In most cases, mature trophozoites contain a prominent central vacuole. Infected red blood cells commonly contained only 1 parasite (Figs. 1–3) and occasionally, after merogony, formed binary pyriform merozoites (Fig. 4). Maltese cross tetrads and hemozoin pigment were not detected. Mackerras's (1959) description of *Babesia thylacis* is very close to our observations in the northern quoll. However, unlike the original description, we did not observe altered (enlarged, pale color) erythrocytes as a result of parasitism, nor were erythrocytes found to contain 4 or more daughter cells.

Only 6 species of *Babesia* have been reported in Australia and, with the exception of *B. thylacis* and *Babesia tachyglossi,* all are nonnative parasites (Backhouse and Bollinger, 1959; Mahoney et al., 1977). From available descriptions, known hosts and locality, the parasite we observed appears to be indistinguishable from *B. thylacis* first described in *Isoodon macrourus* (=*Thylacis obesulus*) (Mackerras, 1959). Reports of *B. thylacis* have been confined to 2 species of Australian bandicoots (Marsupialia: Peramelidae), *Isoodon macrourus* (short-nosed bandicoot), and *Pera-*



Figures 1–4. Photographs of *Babesia thylacis* (darts) in erythrocytes of *Dasyurus hallucatus*. 1–3. Single annular or pyriform trophozoites presenting varying distribution of chromatin. 4. Binary forms (merozoites). Scale bar = 6 μm.

melas nasuta (long-nosed bandicoot) collected near Brisbane, Queensland (L. Cannon, pers. comm.). Additionally, Mackerras (1959) mentioned parasites generally resembling *B. thylacis* from a short-nosed echidna, *Tachyglossus aculeatus* (Monotremata), collected in New South Wales, but these were far more pleomorphic in stained preparations. This parasite was subsequently described by Backhouse and Bollinger (1959) as *B. tachyglossi*. If correct, *B. thylacis* in the northern quoll would extend the known range of this multihost species from the eastern coast of Queensland to northern Western Australia. Although common practice in the past, we agree with Levine (1971) that giving new names to piroplasms merely because they are found in new hosts is not warranted unless there are clear differences from those that have already been described.

The northern quoll or northern native "cat," *Dasyurus hallucatus* (Gould, 1842), is the smallest of 6 species in the genus *Dasyurus* E. Geoffroy St.-Hilaire, 1796 (Nowak, 1991). The northern quoll is restricted to Australia, and the genus, in general, to Australasia. A predacious marsupial and nocturnal in habit, it is fairly common in woodland and rocky areas. Although *Dasyurus hallucatus* has been used commonly for laboratory studies in physiology and ontogeny, relatively little is known about its natural ecology or

parasitic fauna (Schmitt et al., 1989). This appears to be the first report of a babesiosis identified in *D. hallucatus*.

Levine (1988) identified 111 species in the genus *Babesia* Starcovici, 1893, most representatives occurring in mammalian orders, particularly rodents, and a few birds and reptiles. *Babesia* represents a large and diverse assemblage of organisms, yet only three species are known to naturally infect marsupials—*Babesia brasiliensis* Regendanz and Kikuth, 1928; *Babesia ernestoi* DA Serra Freire, 1979; and *B. thylacis*, Markerras, 1959. Two have been described in American marsupials, *Didelphis marsupialis* (*B. brasiliensis, B. ernestoi*), *Didelphis albiventris, Philander opossum,* and *Metachirus nudicaudatus* (*B. brasiliensis*), all in South America (Ayala et al., 1973; Serra Freire, 1979; Herrera and Urdaneta-Morales, 1991). It appears that *B. thylacis* is the only described representative found in Old World marsupials. Interestingly, despite extensive reviews, *B. thylacis* was overlooked as a named species by Levine (1971, 1973) and Ristic and Lewis (1977). Moreover, this species is not included in the most current Index-Catalogue of Medical and Veterinary Zoology (Protozoa), an apparent oversight (R. Lichtenfels, pers. comm.). Telford et al. (1993) included this species in a list of 78 nonruminant mammalian *Babesia* but incorrectly attributed the, now presumed extinct, Tasmanian wolf (*Thylacinus cynocephalus*) as the type host. Eventually, Levine (1988) correctly identified *B. thylacis* from the literature. The single type blood slide of *B. thylacis* (syntypes G 2436) is held at the Queensland Museum, Brisbane.

As far as is known, *Babesia* are exclusively transmitted by Ixodid or Argasid ticks (Young and Morzaria, 1986). In Australia, all 3 marsupials identified with *B. thylacis* can occur together and thus may be preyed upon by the same vector species. The vector of this parasite is not known.

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Literature Cited

Ayala, S. C., A. D'Alessandro, R. Mackenzie, and D. Angel. 1973. Hemoparasite infections in 830 wild animals from the eastern Llanos of Colombia. Journal of Parasitology 59:52–59.

Backhouse, T. C., and A. Bollinger. 1959. *Babesia tachyglossi* n. sp. from the echidna *Tachyglossus aculeatus*. Journal of Protozoology 6:320–322.

Herrera, L., and S. Urdaneta-Morales. 1991. *Didelphis marsupialis*: reservoir of *Babesia brasiliensis* in the Valley of Caracas (Venezuela). Acta Cientifica Venezolana 42:45–46.

Levine, N. D. 1971. Taxonomy of the Piroplasms. Transactions of the American Microscopical Society 90:2–33.

———. 1973. Protozoan Parasites of Domestic Animals and of Man, 2nd ed. Burgess, Minneapolis, Minnesota. 406 pp.

———. 1988. The Protozoan Phylum Apicomplexa. Vol. 2. CRC Press, Boca Raton, Florida. 154 pp.

Mackerras, M. J. 1959. The Haematozoa of Australian mammals. Australian Journal of Zoology 7:105–135.

Mahoney, D. F., I. G. Wright, W. M. Frerichs, G. Groenendyk, B. M. O'Sullivan, M. C. Roberts, and A. H. Waddell. 1977. The identification of *Babesia equi* in Australia. Australian Veterinary Journal 53:461–464.

Nowak, R. M. 1991. Walker's Mammals of the World, 5th ed. Vols. I and II. The Johns Hopkins University Press, Baltimore, Maryland. 1,629 pp.

Ristic, M., and G. E. Lewis, Jr. 1977. *Babesia* in man and wild and laboratory-adapted animals. Pages 53–76 *in* J. P. Kreier, ed. Parasitic Protozoa. Vol. 4. Academic Press, New York.

Schmitt, L. H., A. J. Bradley, C. M. Kemper, D. J. Kitchener, W. F. Humphreys, and R. A. How. 1989. Ecology and physiology of the northern quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae) at Mitchell Plateau, Kimberley, Western Australia. Journal of Zoology 217:539–558.

Serra Freire, N. M. Da. 1979. *Babesia ernestoi* sp. n., in *Didelphis marsupialis* L., 1758, and *D. albiventris* Lund, 1841, in Brazil. Zentralblatt für Veterinarmedizin, Riche B 26:614–622.

Telford III, S. R., A. Gorenflot, P. Brasseur, and A. Spielman. 1993. Babesial infections in humans and wildlife. Pages 1–47 *in* J. P. Kreier, ed. Parasitic Protozoa. Vol. 5. Academic Press, San Diego, California.

Young, A. S., and S. P. Morzaria. 1986. Biology of *Babesia*. Parasitology Today 2:211–219.